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A THEOREM ABOUT NINES

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This theorem talks about the square of a number of 9's, such as 9^2, 99^2, 999^2. If you punch a number for squaring in a calculator of more than five 9's, then it turns out as an expansion number [scientific notation]. Everybody knows $9^2 = 81$, $99^2 = 9801$, $999^2 = 998001$, but not many people know $9999999999^2 = 99999999980000000001$. It is easy to see the sequence. They just repeat 9,8,0,1. If n = the number of 9's, then the formula is (n-1) 9's, 8, (n-1)0's, 1.

To prove $9999^2 = 99980001$: $9999^2 = (10000\text{-}1)^2 = 10000^2 - 2\cdot 10000 + 1 = 100000000 - 20000 + 1 = 99980001$. Likewise: $(10^n - 1)^2 = 10^{2n} - 2\cdot 10^n + 1 = 1\underbrace{0\ldots0}_{2n\text{ zeros}} - 2\underbrace{0\ldots0}_{n\text{ zeros}} + 1 = \underbrace{9\ldots9}_{(n-1)9\text{'s}}\,8\,\underbrace{0\ldots0}_{n\text{ zeros}} + 1 = \underbrace{9\ldots9}_{(n-1)9\text{'s}}\,8\,\underbrace{0\ldots0}_{(n-1)\text{ zeros}}\,1$.

Teacher's note: Jung-mee Kim had been a student at Fenwick for a little more than a year when she discovered this theorem on her calculator. Although she has been using English for only a couple of years, her proof of the theorem shows that mathematics is a universal language.

Catherine Mulligan
